

Heavy Flavour Measurements with ALICE

G. Batigne, Subatech
for the ALICE Collaboration
July 18th 2010

- Physics case
- ALICE reminder
- First results on open heavy flavour
- First results on quarkonia

Heavy Flavours in Heavy Ions

Heavy quarks:

- formed at the early stage of the collision: 0.03–0.1 fm/c
- long $c\tau$ of hadrons with open/hidden heavy flavour

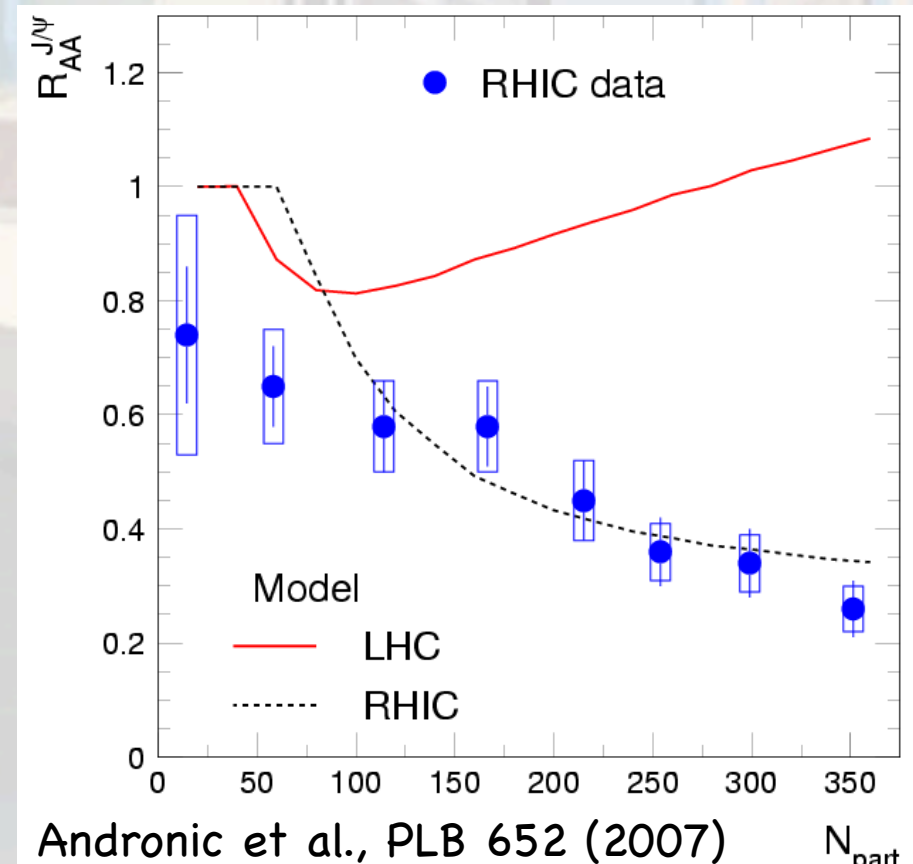
The Quark Gluon Plasma should last @ LHC more than 10 fm/c

⇒ Good probe of the medium

Characterisation of the medium crossed by heavy quarks:

- energy loss
c & b heavier than u, d, s + dead cone effect
- quarkonium production:
melting in medium vs stochastic recombination

	RHIC AuAu centr. @ 200GeV	LHC PbPb centr. @ 5.5TeV
$c\bar{c}$	10	115
$b\bar{b}$	0.5	5



Heavy Ion collisions in 2010 @ LHC

First Heavy Ion Run should start in November 2010:

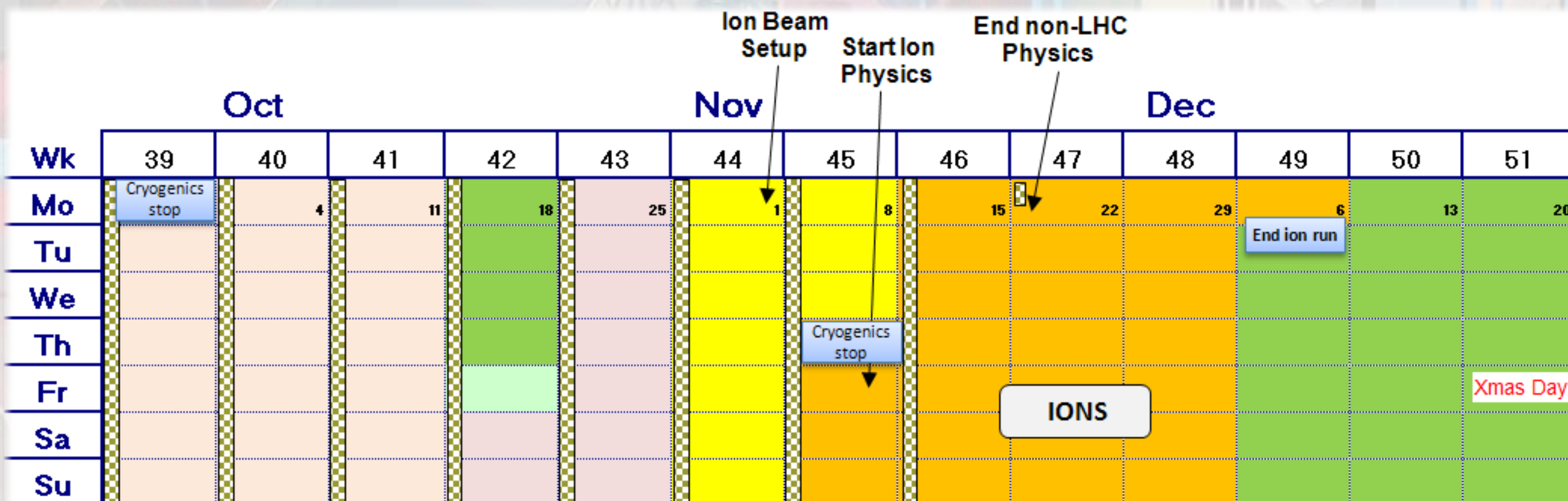
PbPb at 2.76 TeV (82/208 x 7 TeV)

Max luminosity $10^{25} \text{ cm}^{-2}\text{s}^{-1}$

⇒ ~100 Hz Minimum Bias during 1 month

⇒ **10^8 events**

with data recording bandwidth at 1.25 GB/s (20MB/s in pp)



Heavy Flavours in Proton-Proton

pp collisions used as reference data for heavy ion collisions

Binary nucleon-nucleon collisions scaling

Nuclear modification factor: $R_{AA} = \frac{1}{N_{coll}} \frac{dN_{AA}}{dN_{pp}}$

Data interesting for itself:

measure charm & beauty production cross sections

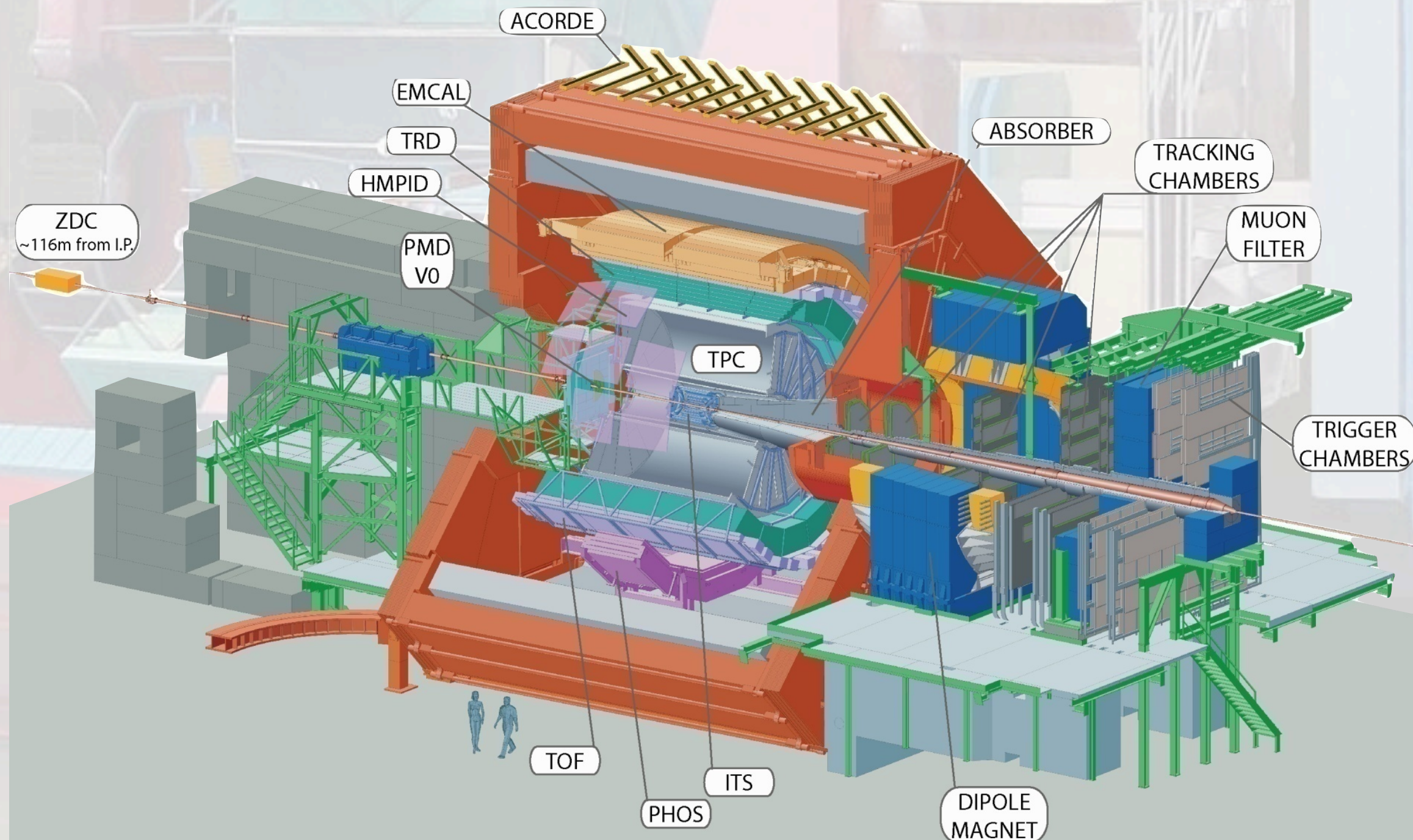
Comparison with pQCD

Probe the gluon distribution (very low x-Björken down to $4 \cdot 10^{-6}$)

Saturation effect

Presented results concern 7TeV data

pp collisions will be also interesting to better understand cold nuclear effects



Central barrel: $|\eta| < 0.9$

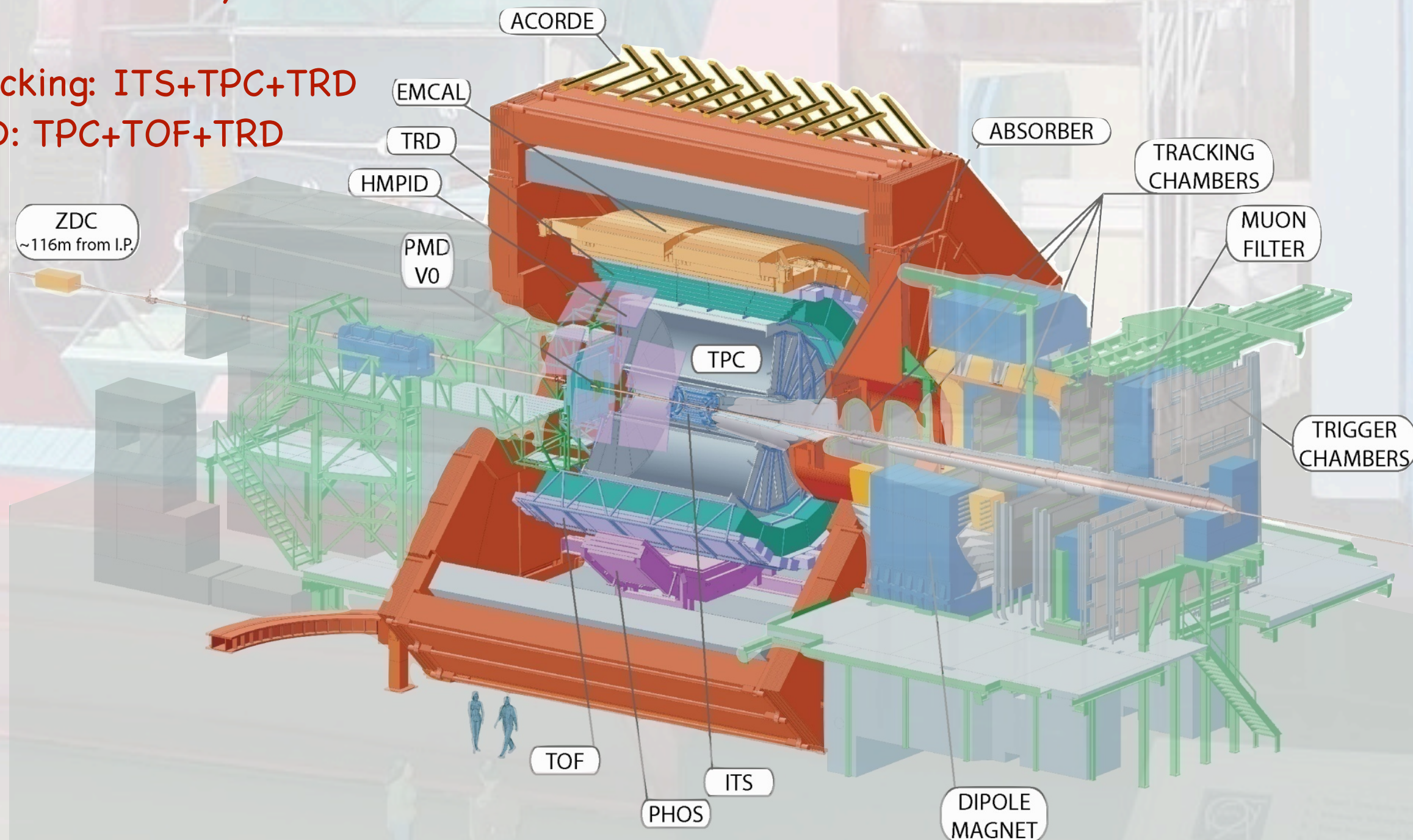
Open heavy flavour:

hadronic & semi-leptonic decays (e)

Quarkonium: decays in e^+e^-

Tracking: ITS+TPC+TRD

PID: TPC+TOF+TRD



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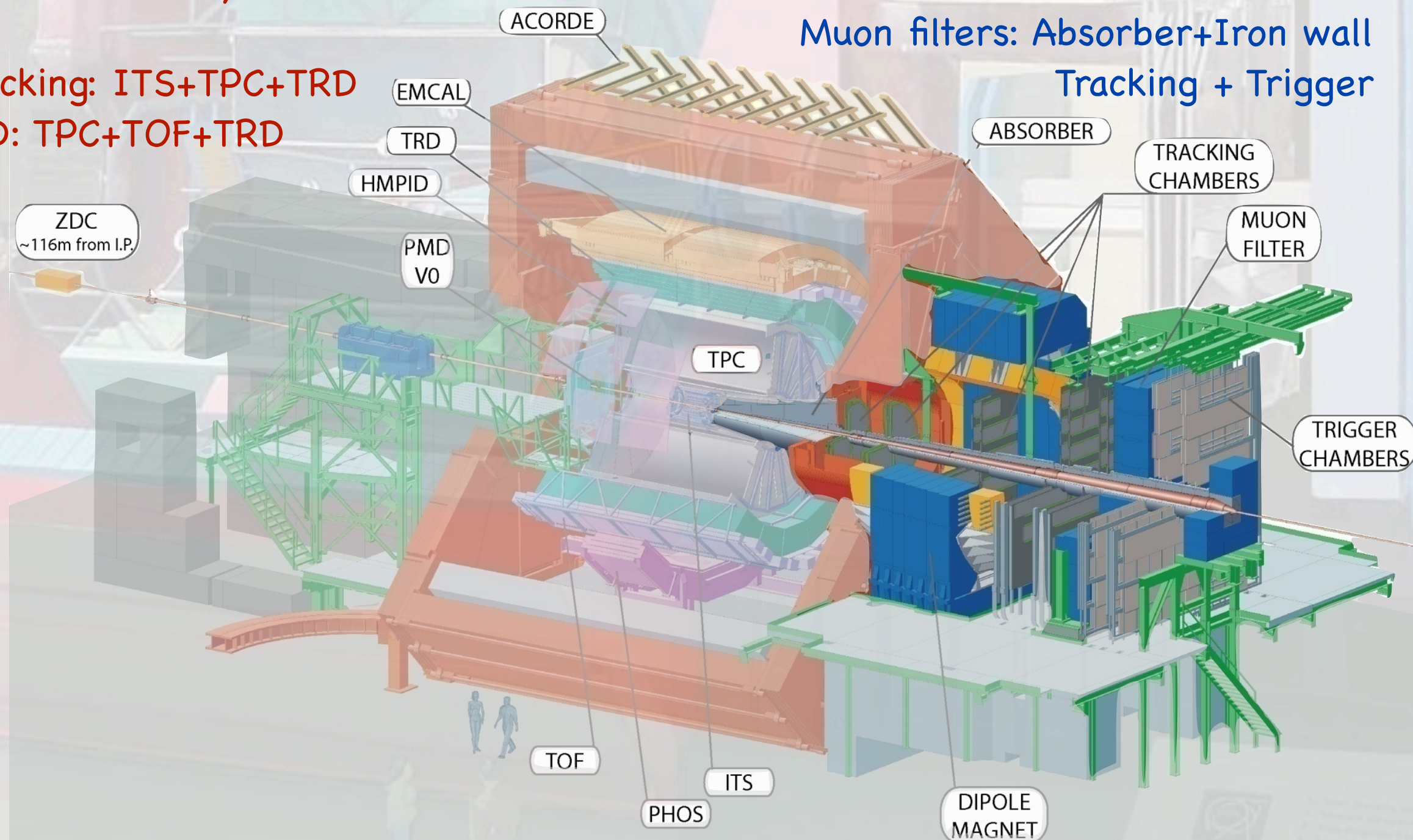
Tracking: ITS+TPC+TRD

PID: TPC+TOF+TRD

Muon Arm: $-4 < \eta < -2.5$

Open heavy flavour and Quarkonii:
muonic channels

Muon filters: Absorber+Iron wall
Tracking + Trigger

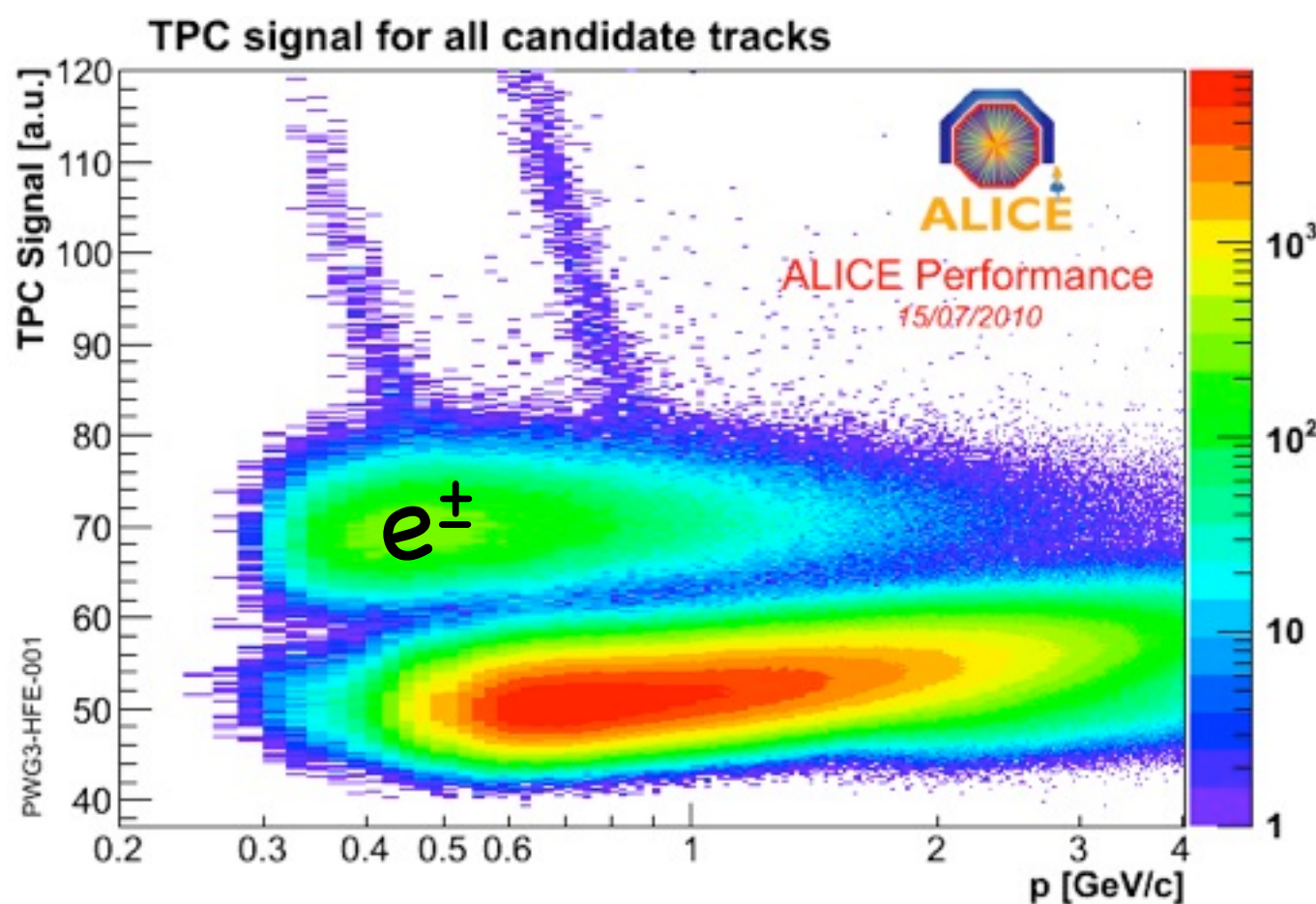


Measurement of the inclusive charm & beauty cross-section

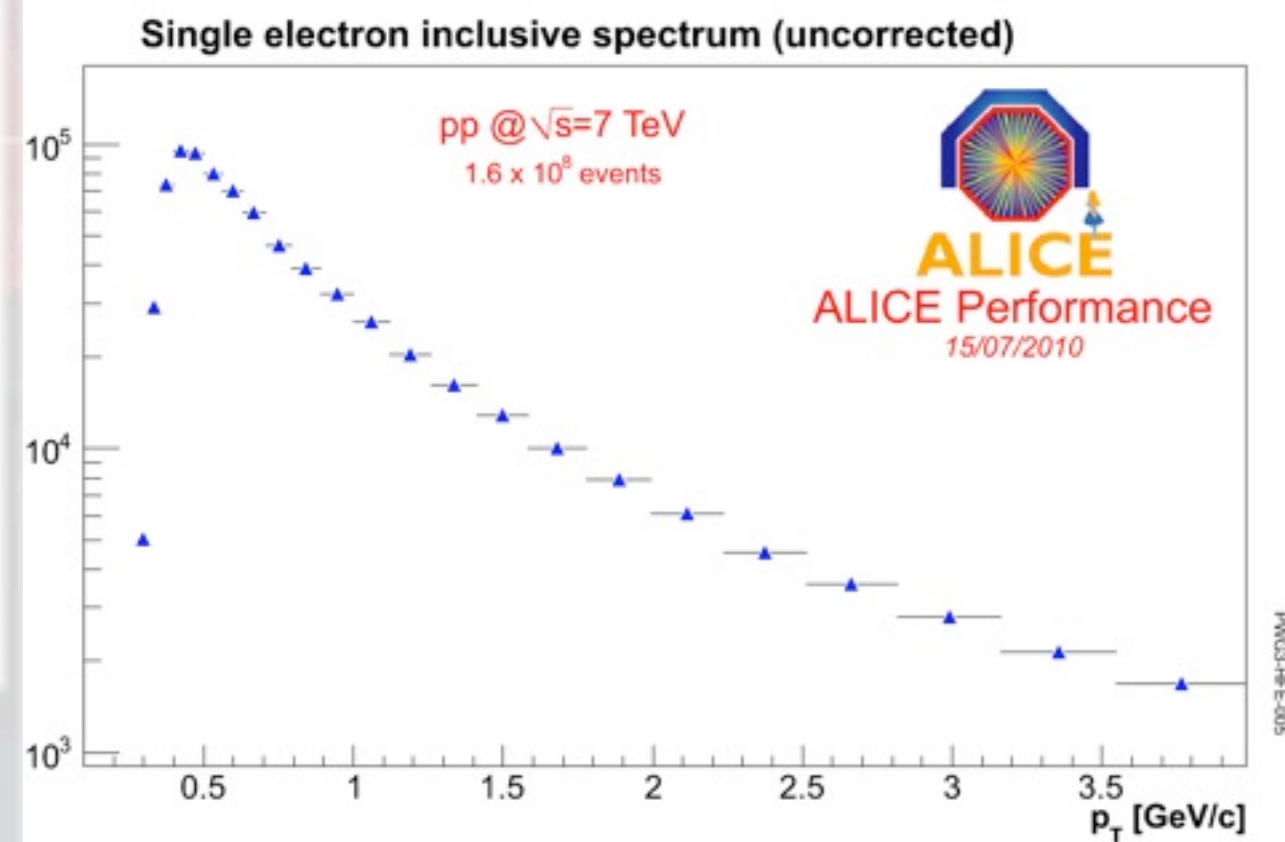
Heavy quark contributions become more dominant at high p_T

Electron selection: Cuts on TOF (K,p)

Cuts on dE/dx in TPC for π (TRD and EmCal will be used soon)



not corrected from
acceptance, efficiency and bremsstrahlung
include photonic-electrons and Dalitz decays

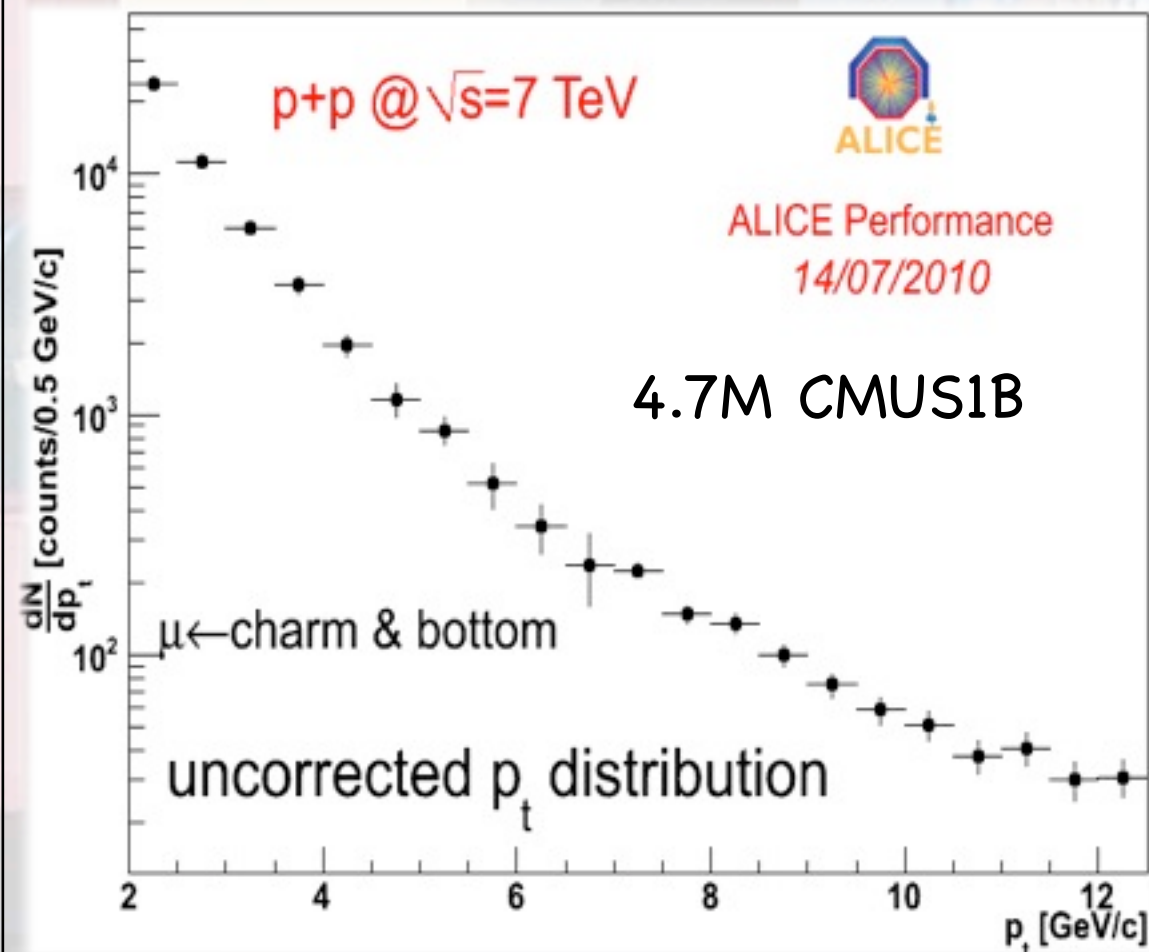
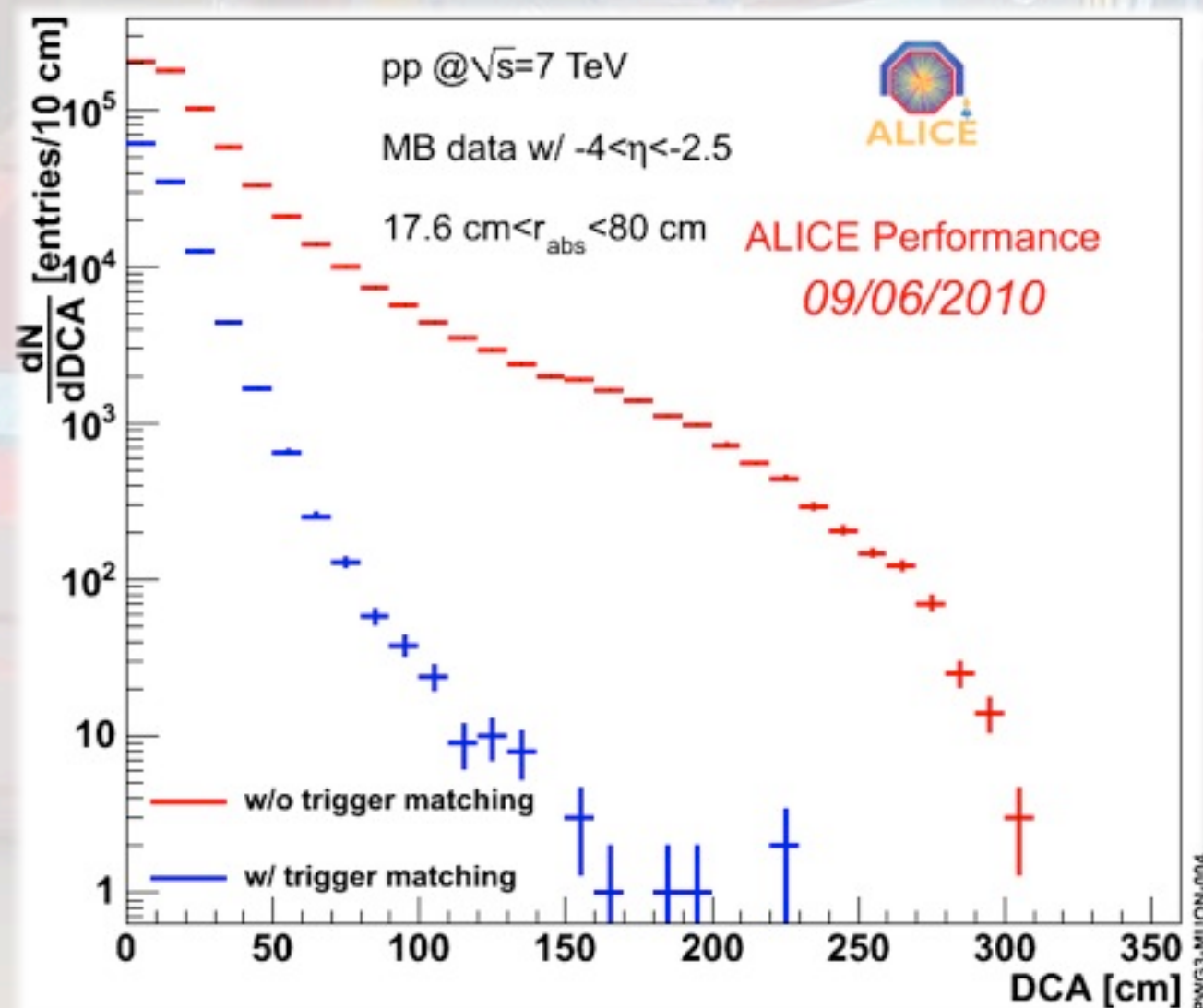


In the muon arm:

no PID & no vertexing (out of SPD acceptance + interactions within the absorber)

Trigger matching: remove hadrons created in the frontal absorber (iron wall)

DCA: separate c and b contributions by fitting data with simulated distributions



π , K contributions subtracted using Pythia + normalised at low p_T

c & b dominate for $p_T > 2 \text{ GeV}/c$

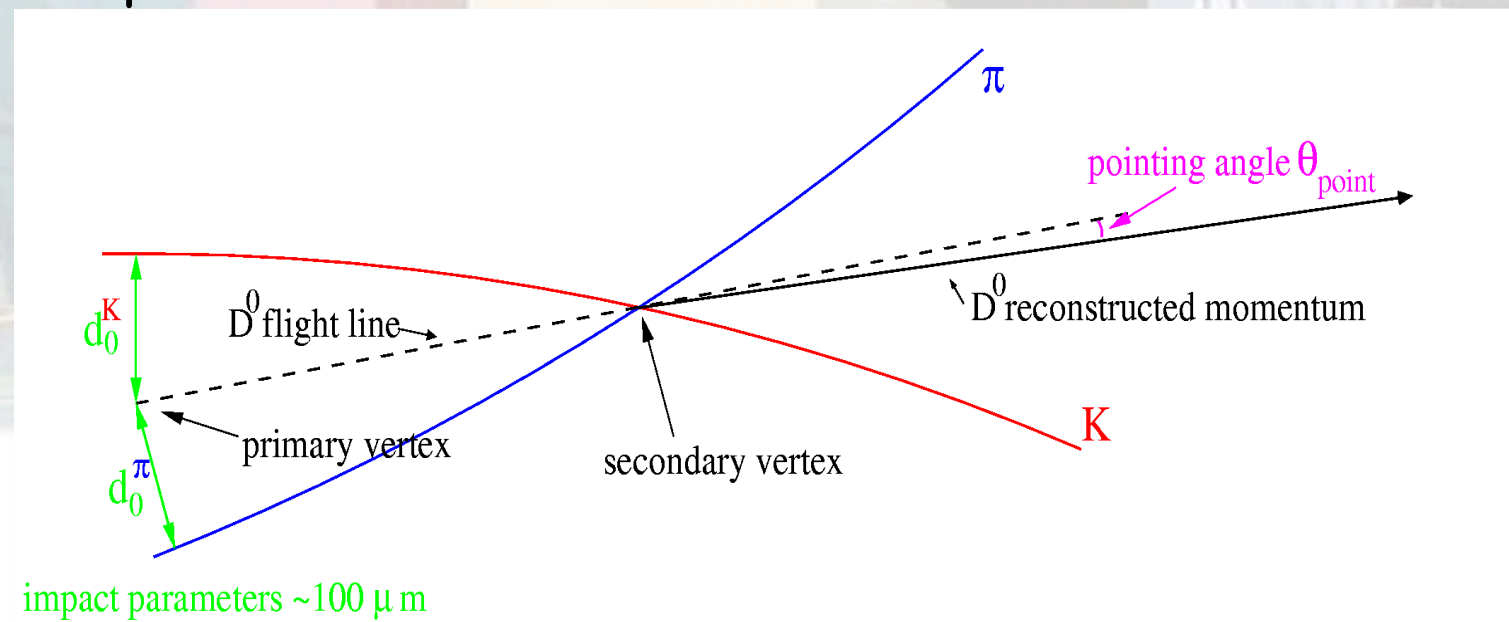
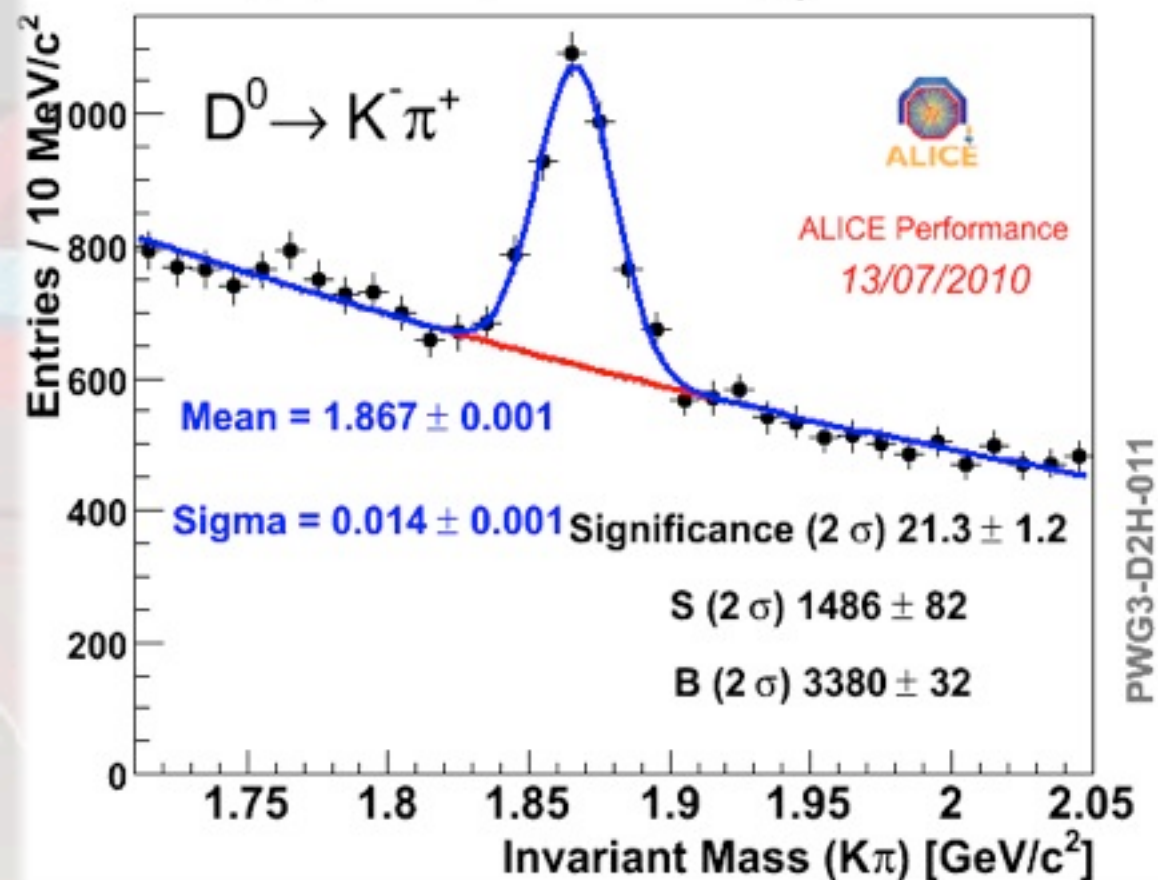
Topological selection:

2 unlike sign particles
displaced vertex and large impact parameter

TPC + TOF for PID

Example: $D^0 \rightarrow K^- \pi^+$

pp $\sqrt{s} = 7$ TeV, 1.4×10^8 events, $p_t^{D^0} > 2$ GeV/c

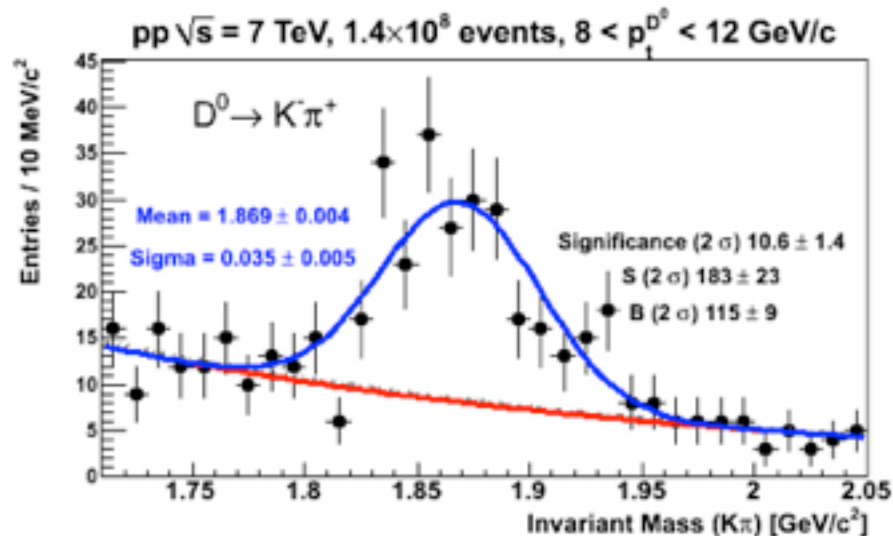
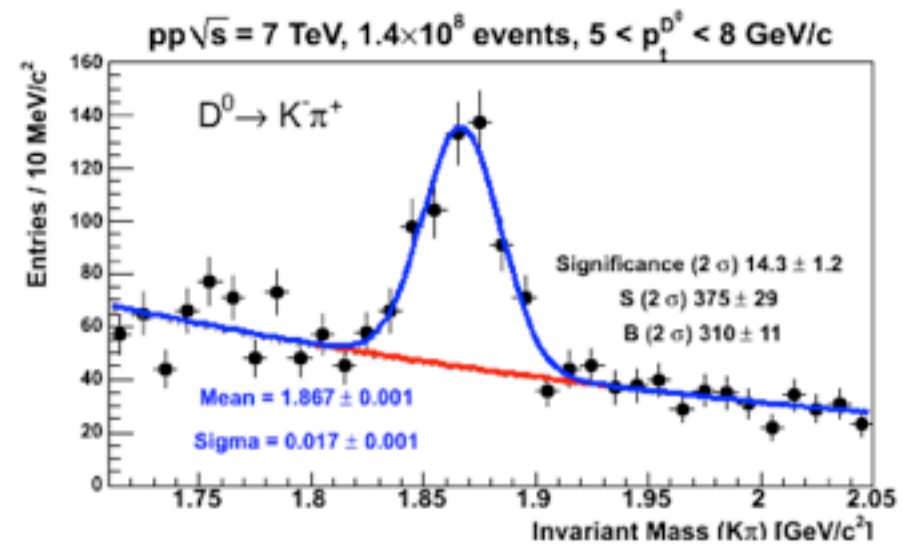
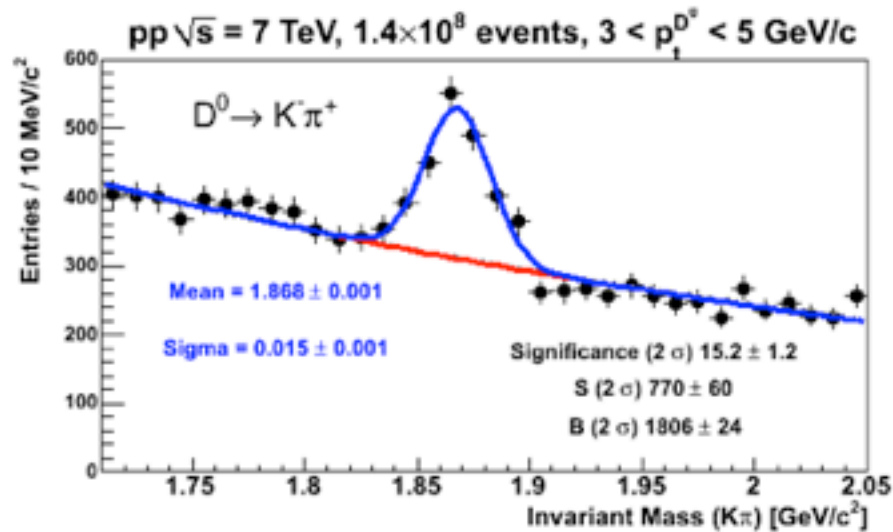
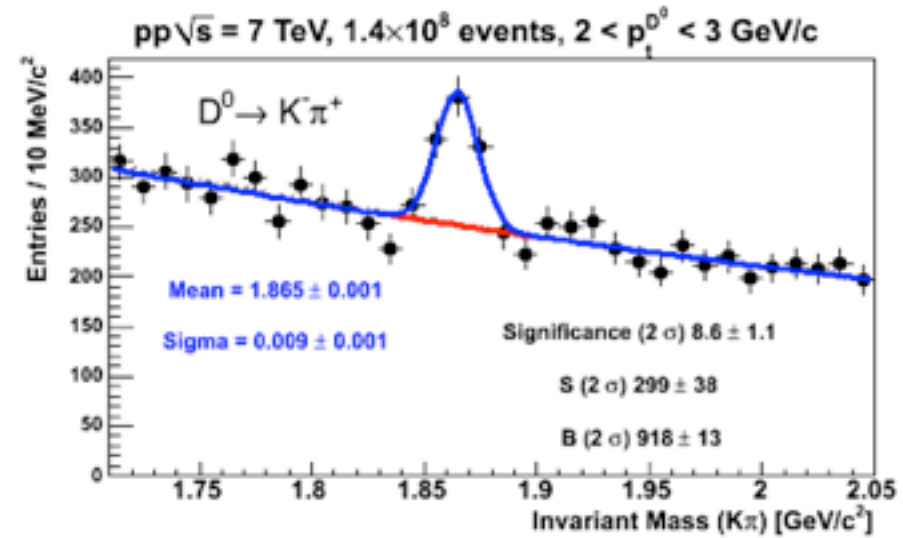
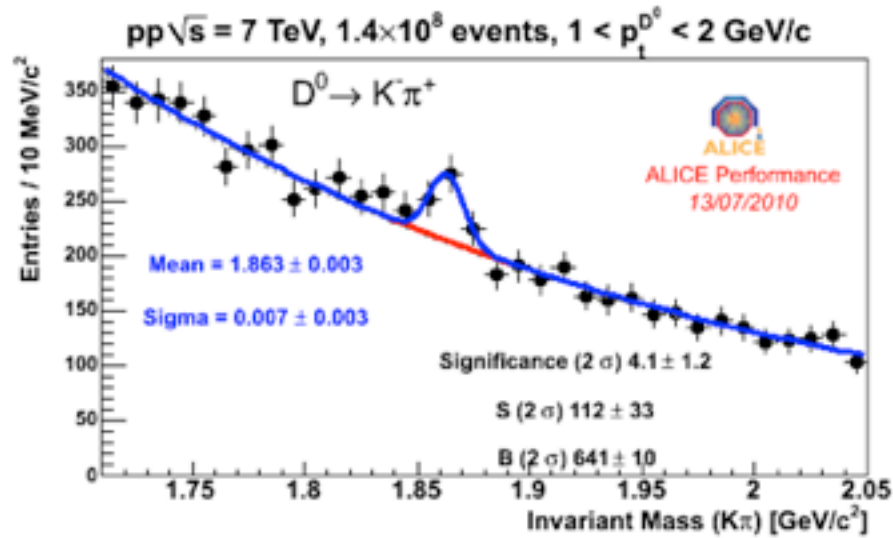


Topology

2
dis

TPC + T

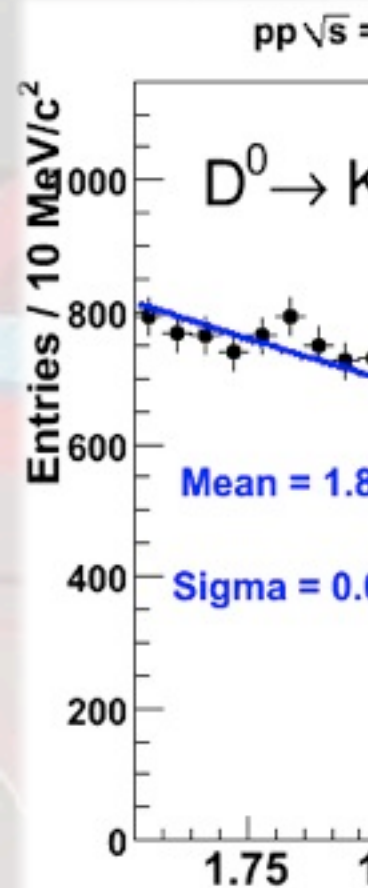
Example



angle θ_{point}
momentum

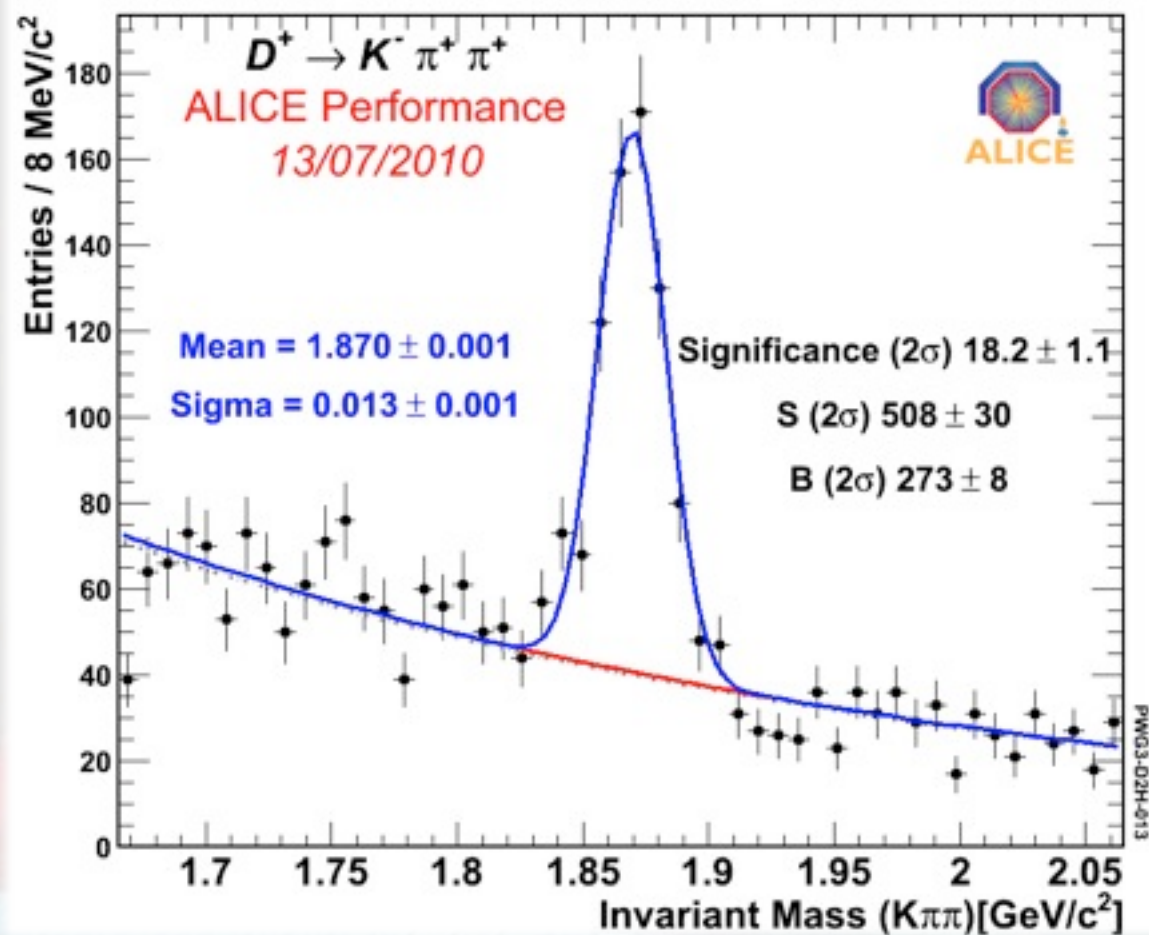
PWG3-D2H-012

5 bins in p_T
p_T > 1 GeV/c

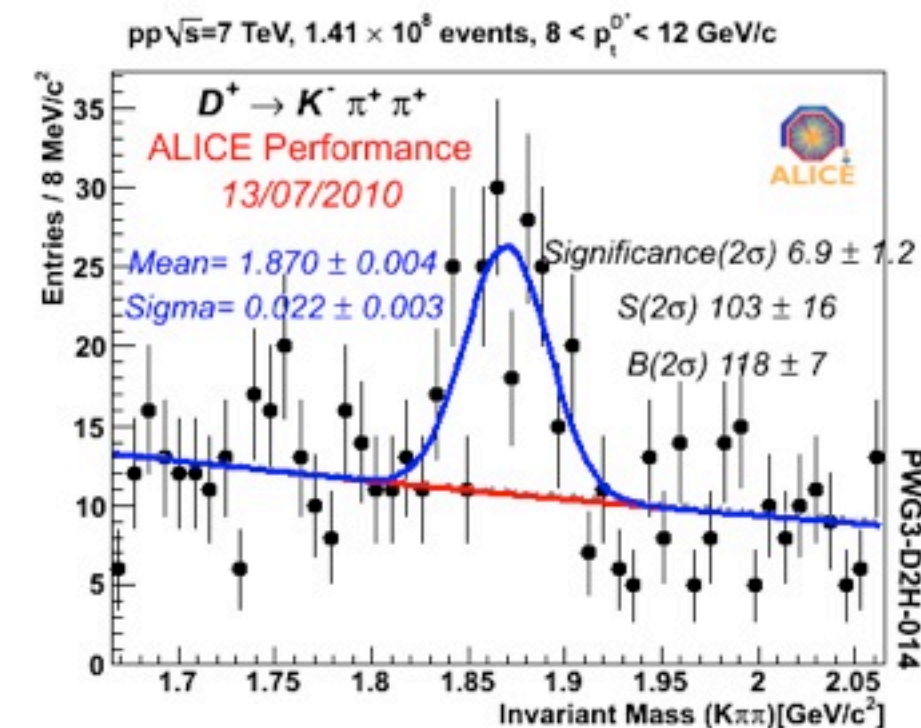
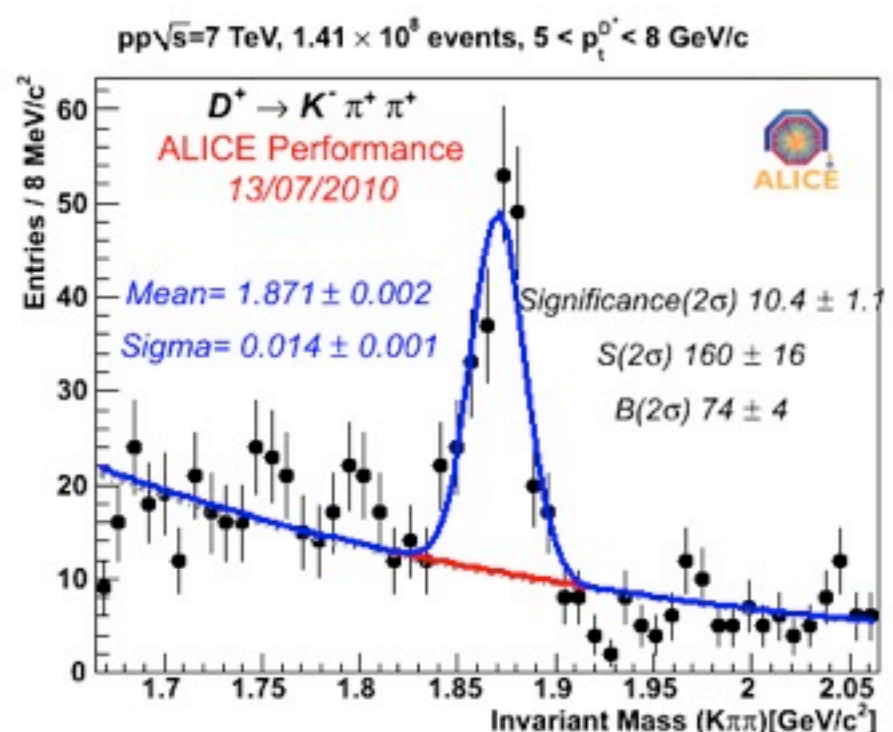
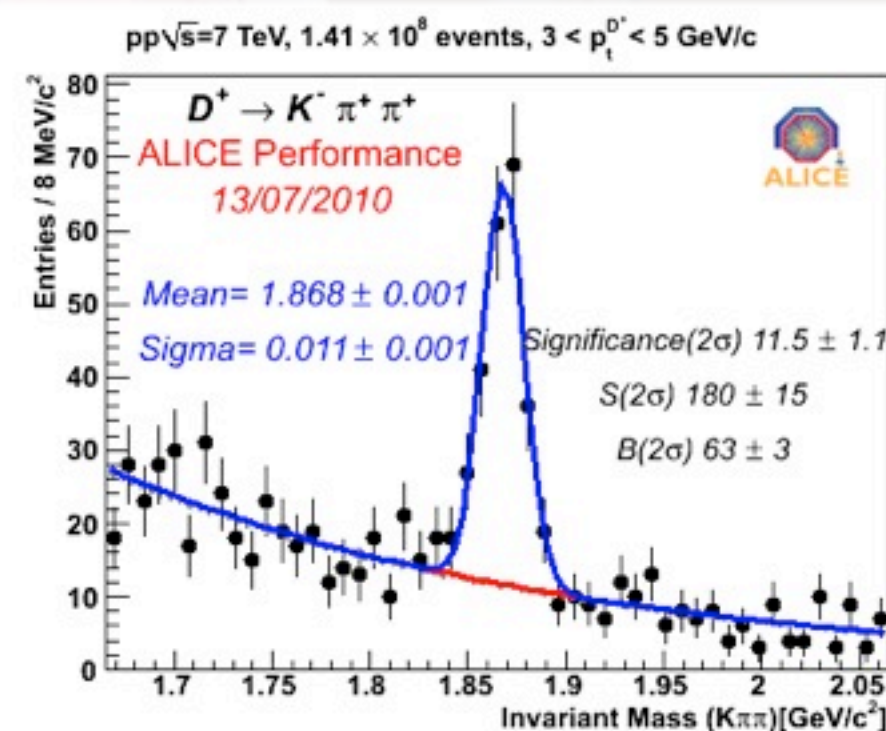
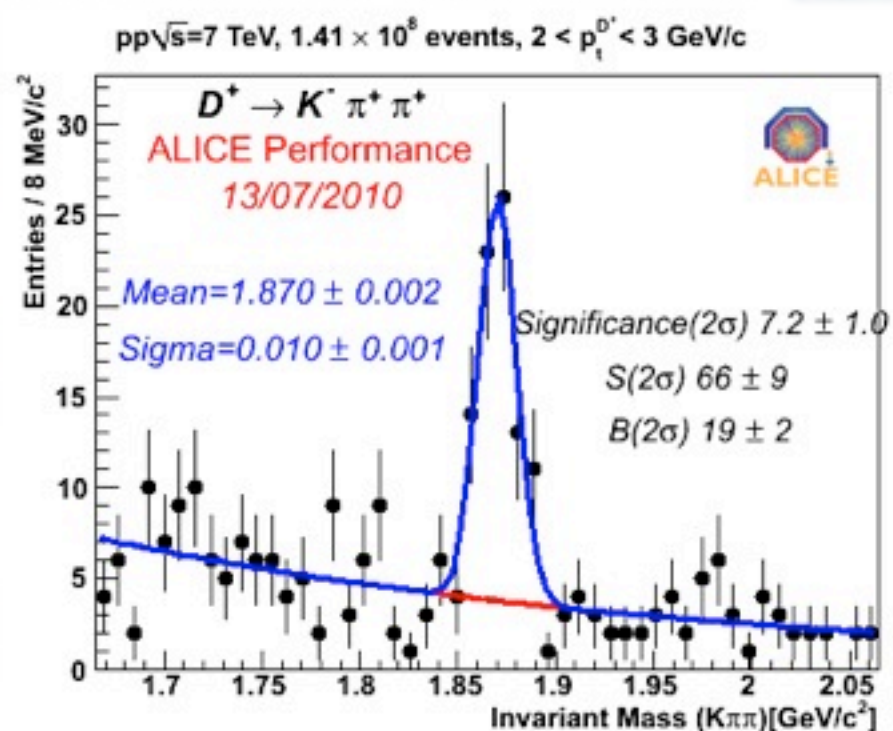
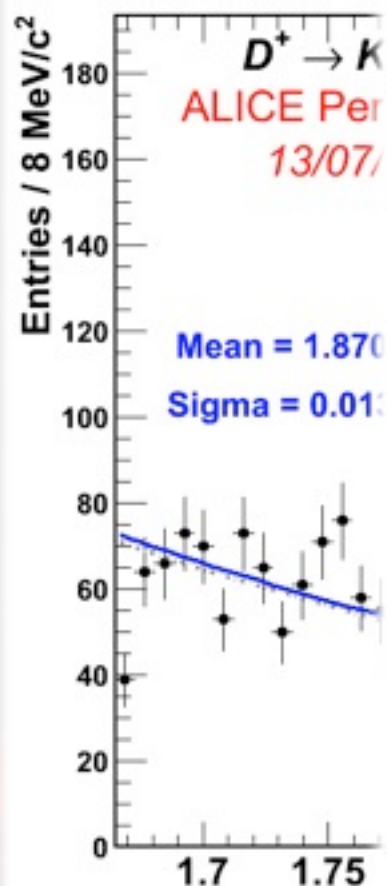


$D^\pm D^*$ Analysis

$pp\sqrt{s}=7\text{ TeV}$, 1.41×10^8 events, $p_t^{D^*} > 2\text{ GeV}/c$

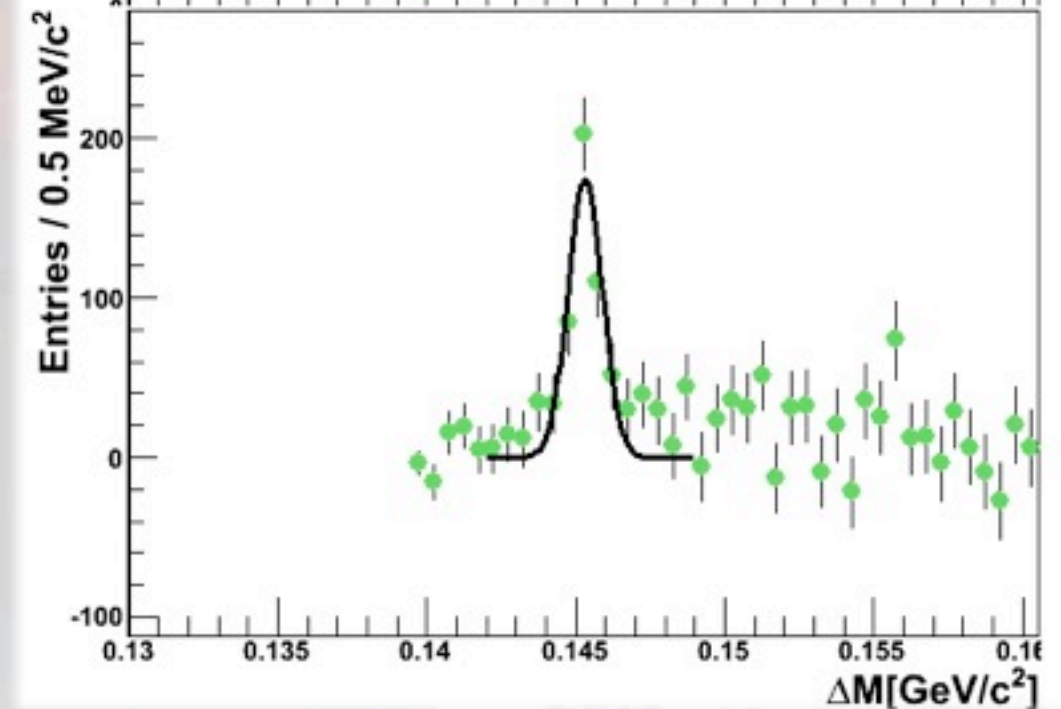
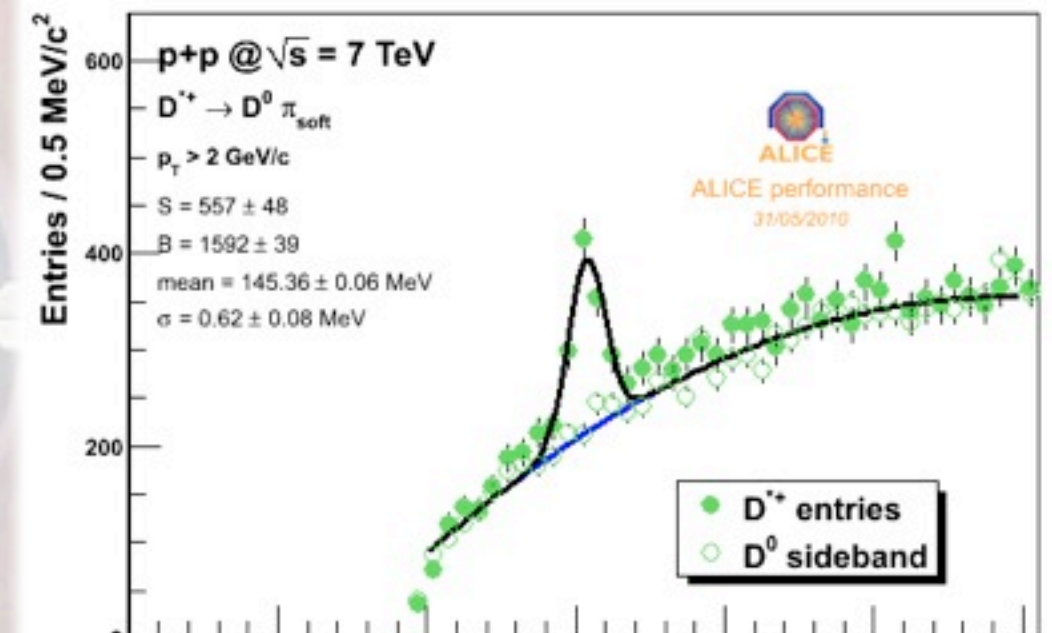
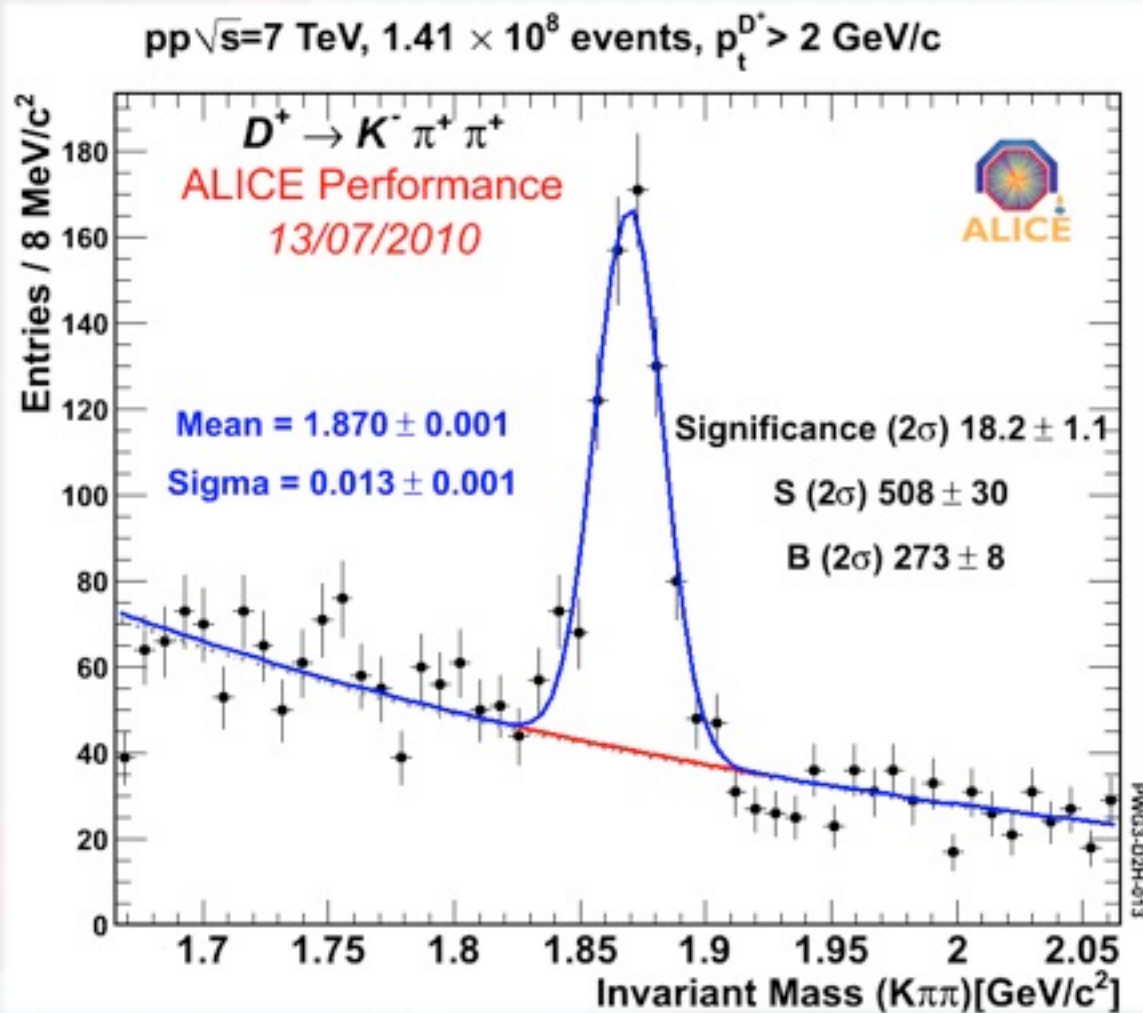


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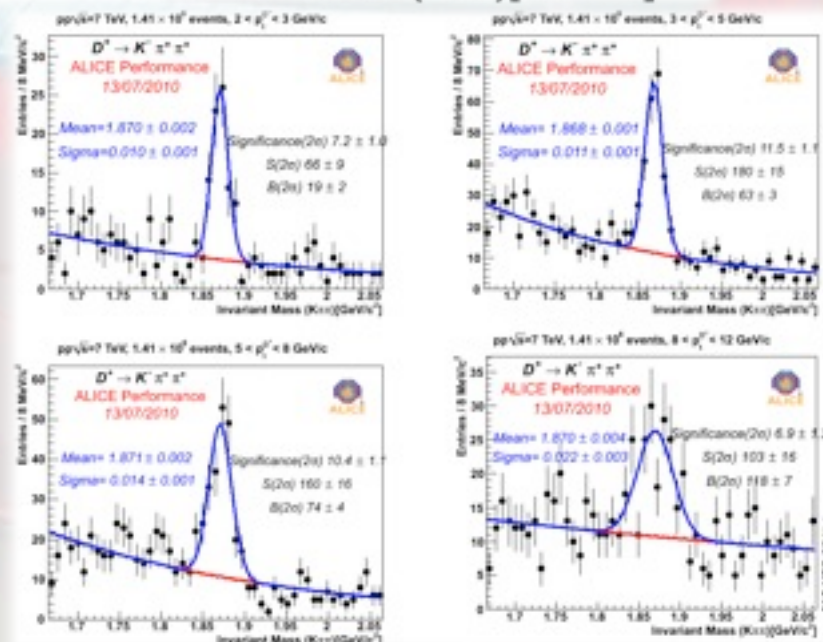


PWG3-D2H-014

Background estimated using side bands around D⁰ invariant mass: $\pm(4-8)\sigma$

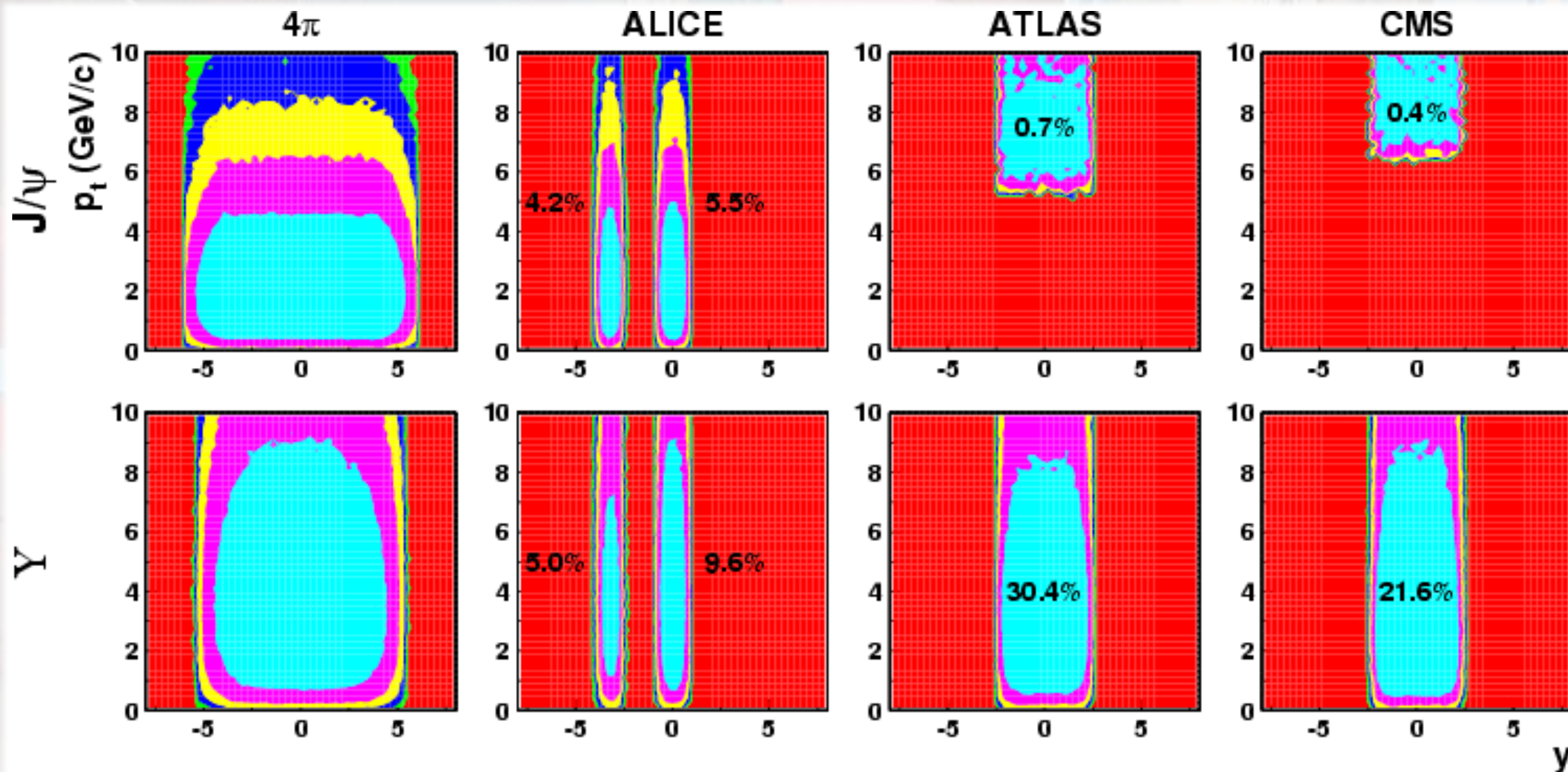


4 bins in p_T



Ability to measure Quarkonia at low p_T ($\approx 0 \text{ GeV/c}$) and larger rapidity

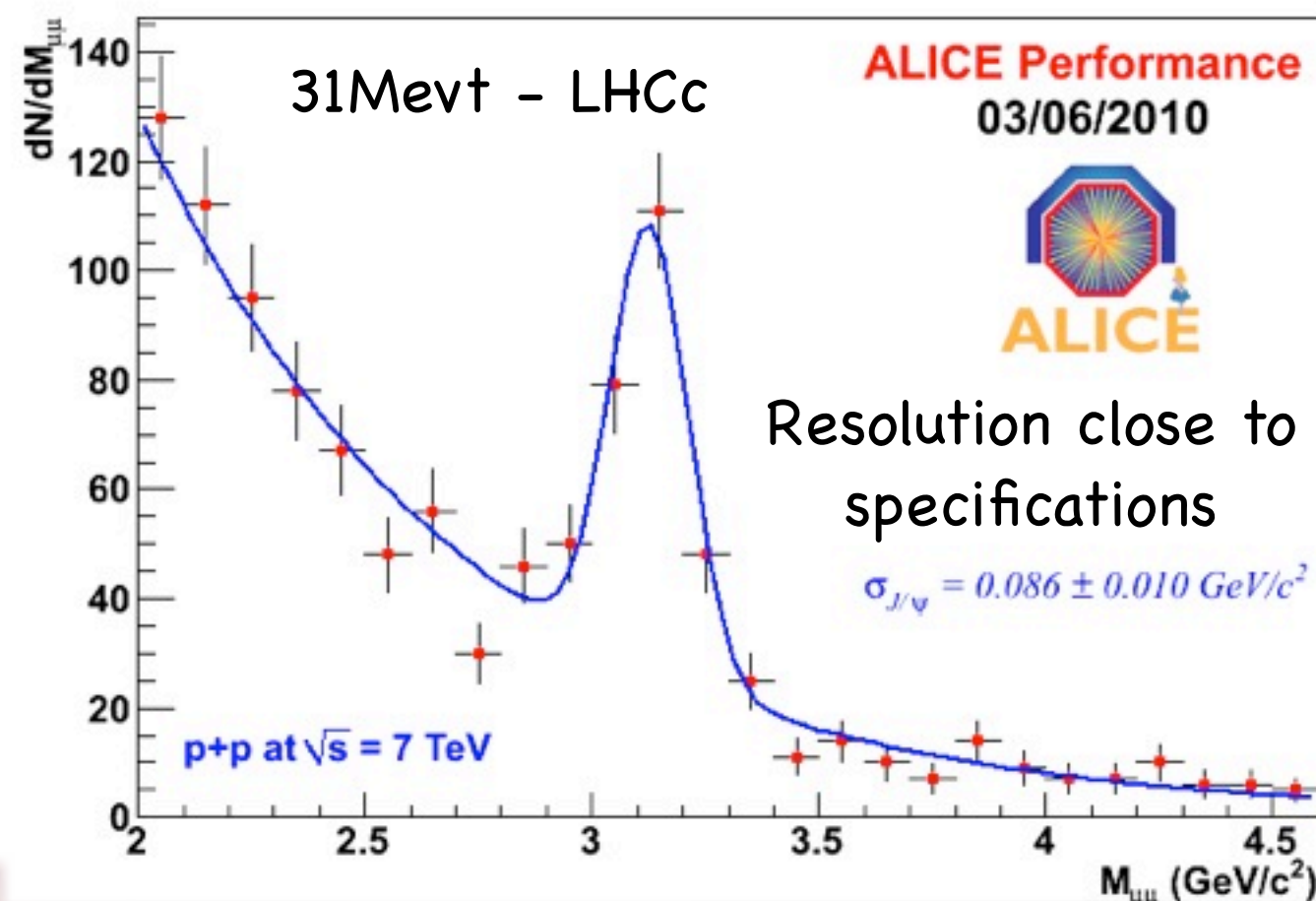
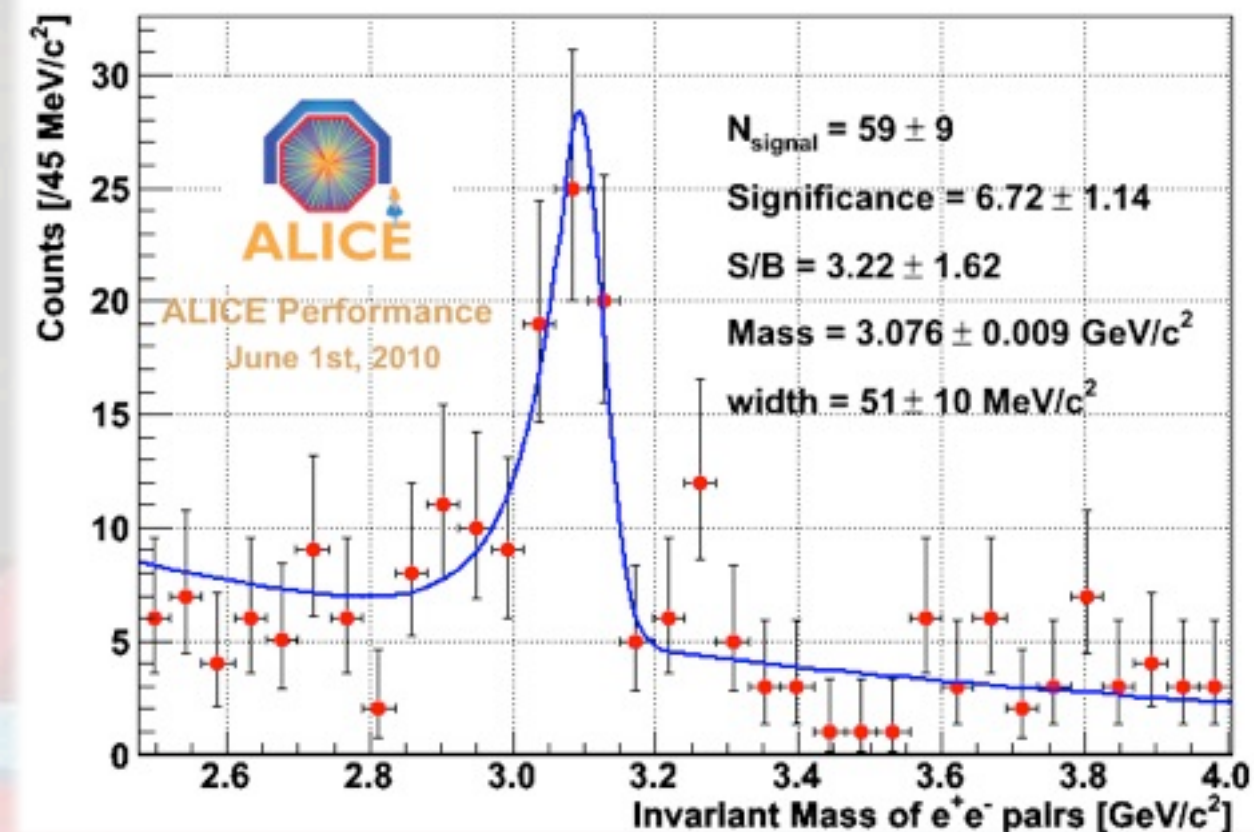
For heavy ion collisions:



Central barrel ($|\eta| < 0.9$)

110 MeV after physics selection

Muon arm ($-4 < \eta < -2.5$)



Dependence in p_T is underway (coming very very soon)

Feed-down from Beauty has to be subtracted (~20%)

⇒ importance to measure open heavy flavour hadrons

With coming statistics, one expects the ψ' signal

Heavy flavour in ALICE:

Used as probe of the medium created in heavy ion collision
Acceptance complementary to other LHC experiments
low p_T + mid/forward rapidities

First results in pp@7TeV:

Ability to measure open and hidden heavy flavour mesons
single leptons
D family & J/ψ
Resolution close to the nominal result
as expected from MC simulation of the detector

Results to come:

- 1) Start the study in transverse momentum and rapidity
- 2) Extending electron PID to higher p_T with the ALICE TRD
- 3) Extraction of production cross-section of charmed hadrons, single muons, non-photonic electrons and in pp @ 7TeV

Eagerly waiting for PbPb collisions this Fall !!

Heavy fl

First res

Results



non-photonic electrons and in pp @ 7TeV

le muons,

Eagerly waiting for PbPb collisions this Fall !!



Henri II

heavy



François 1^{er}

labour

Charm



Catherine de Medici

vs

Beauty



Diane de Poitiers